CALFED Ecosystem Restoration Program
2001 Proposal Solicitation Package
April 12, 2000 Public Pre-submittal Workshop

Conceptual Modeling Discussion

The Questions and Answers from the April 12, 2000 Pre-submittal Workshop were mailed out previously. This document is a summary of the Conceptual Modeling discussion that occurred from 3:00 – 4:30 on April 12th and the Conceptual Modeling workshop, which was held on April 21st.

On April 12th, four members of CALFED's Ecosystem Restoration Program Interim Science Board gave a presentation on adaptive management and conceptual modeling.

Dennis Murphy, University of Nevada (overheads attached)

Conceptual models identify the cause and effect pathways by which restoration actions or studies of systems may improve ecosystem functions. Five potential contributions of conceptual models include:

1) they characterize the linkage between proposed actions and predicted outcomes
2) they link elements and processes of the system to allow hypotheses to be constructed and to identify uncertainties
3) they explore areas of cause and effect relationships
4) they help organize the management approach. Actions themselves are developed around key interactions of ecosystem elements drawn out of the conceptual model
5) they guide the development of monitoring schemes essential to turn traditional management to adaptive management

Adaptive management is the process of learning by doing. Adaptive management has become another buzzword. However, CALFED is serious about making adaptive management operational. The Proposal Solicitation Package is based on the ERP Strategic Plan that identifies areas of uncertainty. Each applicant should note that there is an application of each separate project funded into a broader decision-making context for CALFED.

It is important that monitoring questions are clearly articulated so data collected are framed in the appropriate context. Conceptual models allow an applicant to select parameters to be used in the monitoring process. One can infer from the selected measures of the system whether the project has a positive, neutral or negative effect on the system. Indicators are the first step of the data acquisition scheme.

Again note that each project is part of a broader context to meeting the goals of CALFED over the next several decades. For projects this year, how will each project contribute to our base of knowledge to allow us to be more effective, efficient and accountable?

Ken Cummins, Humboldt State University (used slides – copies not available)

There is nothing magical about conceptual models. We develop them all the time in our minds. It is basically the way we organize our thoughts about the way things work. An example of this is a multi-agency project on riparian zones. They took a team approach to developing a conceptual model. In this example, they developed detailed models within a general model. This helps identify things to measure relative to a question, and also allows identification of parts of the system to expand on or form hypotheses about. There is no right or wrong way to develop a conceptual model. It can be verbal or written, either complex or cartoon-like.

In the riparian example, they first developed a list of riparian influences:

-litter inputs
-shading
-geomorphic channel features
-nutrient flux

The next step was to draw a picture or diagram of where things go, where they come from, and which are the major ongoing processes.

One specific issue to address was managing for a riparian buffer strip. The width of the strip would be very different for different processes, and different widths depending on the function. They looked at both spatial and temporal models and then focused on a specific portion of the model: the importance of litter to the stream. They developed a detailed model for that question.

The point of the example is to show the thinking process for how to approach a problem, how to organize information, and how to put things into context to identify the key components that tell us what to measure and monitor. Using an interdisciplinary approach often enhances development of models.

Matt Kondolf, UC Berkeley

Make your internal conceptual models explicit.

Putting your project in context:

1. **Articulate the conceptual model for ecological processes relevant to your project**
   For example, for a gravel project there is a dam upstream, it traps gravel, less gravel is available for fish to spawn. Therefore, gravel should be added to the stream. To articulate the model one should identify the needs for salmon, how the conditions have been altered, and how the proposed project will aid that problem.

2. **Locate your project in the Healey ladder** – (Pg 15 in the PSP)

   The three triangles in the lower right hand corner of the adaptive management diagram represent different levels of understanding. If there is a lot of uncertainty, targeted research would probably yield the best bang for the buck. If some information is known, a pilot project can be conducted observing the response of the system. If there is a better idea of how the system works, then large-scale projects can be done.

   We wouldn't want to jump to large-scale implementation if we don't have a good understanding of the system. We could be doing something all wrong even though we're doing it well and doing a lot of it.

   Note that it is not necessarily a step-wise process. It could be. If you have a project in a well understood area, you need to make that case and propose the action. CALFED is not advocating conducting all research.

3. **Clearly lay out the information benefits of your project and its monitoring/evaluation program**

   The goal is to lay out the benefits of the projects, identifying how this project will yield information so we can learn and do better with future projects.

Example:
SALMON SPAWNING GRAVEL ENHANCEMENT BELOW DAMS

Conceptual models:

1. **Physical Processes**: Dams trap gravel supply from upstream leading to coarse sediment starvation, loss of gravels, loss of spawning habitat. Project proposes to add gravels, either by injection for redistribution or by building riffles.

2. **Ecological Processes**: Life cycle of salmon, role of freshwater gravels in reproduction, limiting factors analysis – *is gravel limiting the salmon population?*

3. Conceptual Model for Your River: Review sediment supply data, evidence for gravel limiting populations, etc. Estimates of gravel mobility and future requirements to add gravel to replace that washed downstream.

Information Richness

Monitoring/evaluation plan to yield information on effectiveness of specific techniques in this river and these sites. E.g., tracer gravels to track downstream movement, monitoring sites downstream to detect immigration of gravels from injection sites, etc.

How much will be learned from this project? The better the monitoring and evaluation is, the more we are likely to learn.

Wim Kimmerer, San Francisco State University (overheads attached)

One note is that the Interim Science Board has been tasked with developing an overall conceptual model for the Bay-Delta ecosystem. The individual models developed by the Board members so far have been very different.

A conceptual model is an articulation of how you think things work and why what you propose will make it better.

For example, is habitat a limiting factor in the life of a salmon? It may or may not be. First, put this question into the larger context. What are all the potential limiting factors? This is not to say that every proposal dealing with salmon has to go through the entire life cycle. However, applicants need to be aware of the other factors, and they need to make the case that the proposed project will help the problem. That case needs to be made on the best available information.

Question and Answer

If an applicant is proposing a large-scale implementation project that is assuming much is known about the issue, then is less monitoring required? In other words, we know certain projects work so how substantial does the monitoring need to be?
Monitoring is critical for all projects. Monitoring is needed to
1) determine is the applicant is doing the thing proposed in the project, and
2) determine if the project is meeting CALFED or CVPIA goals

Historically people have done a very poor job of monitoring anything, and we really do not know how things are going to turn out. Monitoring is very important.

All projects are considered experiments. Therefore, data must be gathered to assess if a project was successful. There is also the issue of scale effects. One scale may have a desired result, but if the action is done at a larger scale, monitoring is critical to see if the desired result occurs at that scale. Also, large-scale actions are often very costly so monitoring is important from a public accountability standpoint to show that money is being spent wisely.

For structural projects such as fish screens on diversions, we know juveniles are lost at unscreened diversions and screening helps. However, it is difficult to measure the ecosystem response to screening. Another type of monitoring is needed for the overall effectiveness of projects.
Yes, in some cases, it is difficult to determine the ecosystem response. Evaluation should occur at both the project level and system-wide.

One note on screens is that it is important to look at all the effects of a structure. For example, installing a screen is fixing the bank of the river at one place. This does not allow river processes to occur such as meander within the floodplain. Alternatives for screens could be evaluated such as varying the timing of the diversion, having the diversion in the middle of the stream, or developing temporary or movable screens.

Some projects are constrained by social or economic factors. How does that fit in with the scientific component?
True. Some projects may not have a strong scientific component. However, it is still important that each project develops a conceptual model describing the cause and effect relationships. There are other criteria within the PSP that take into account some of these other factors such as feasibility, local involvement, cost sharing, etc.

There is a collection of papers in the journal Conservation Ecology, Volume 3 Number 1 and 2 that discuss the relationship between adaptive management and socioeconomic limiting factors. This can be found on the web as http://www.consecol.org. These articles will also have good citations for other related documents.

Should gravel introduction projects be monitoring programmatically?
Gravel replenishment has occurred on the Sacramento River since 1980. Gravel has been added each year in different ways. It is important to understand effects system-wide. This is a good example for learning how the system works through pilot projects. We now have information on when gravel moves and how often. This information can be used as a basis to determine the amount of gravel needed for improvements in the gravel base.

How much of the budget should be allocated for monitoring?
The monitoring budget will depend on the type and scale of the project. No specific amount or percentage can be identified. It is important that monitoring is identified to answer the hypotheses and questions identified in the proposal. It is also important that the monitoring component is an integral part of the project. The monitoring plan will come from the conceptual model and hypotheses posed in the proposal.

A lot of work has been done on experimental design. It's been noted that to learn about a system, restoration should be staggered in different watersheds to test if you're having an effect. Often, there may be a confounding effect, meaning everything improves but it also happens to be a good water year. Has the Interim Science Board looked at the larger scale?
This is the main task for the Interim Science Board. Some concern has been expressed as to how to gain that overarching understanding from projects coming in under a PSP. There is a need to balance an overarching understanding of the system with a variety of projects coming from the local level. The Interim Science Board is identifying potential comprehensive adaptive management experiments. The Board is also discussing the larger scale conceptual model. We are not expecting that applicants can provide the system-wide connection for each project. Applicants can, however, acknowledge the bigger picture.

The Interim Science Board is still determining its role and scope and they realize it is important to focus at the larger scale.

The PSP also encourages collaboration for proposals.

In securing conservation easements to buffer wetlands from urban encroachment, is there a scientific way to monitor this? Can this be done in 3 years (the maximum length of a contract)?
The conceptual model developed should identify what needs to be tracked. This can be developed at a spatial scale and include cost-benefit issues. For monitoring, projects can be proposed in phases. Usually for a trend analysis, at least 5 years of monitoring are needed. The proposal can identify the needs and then apply in future years for monitoring beyond the 3 year time-frame.

How can budgets be developed now when a project will be managed adaptively?
Adaptive management includes learning as a project proceeds. The initial phase of the project can be described, then with completion of the first phase of the project, it can be assessed, and a proposal developed for future work. It is important to learn from the first phase to direct future activities of the project. The CALFED ecosystem restoration program expects to do an annual solicitation with a PSP out in January and decisions made in October of each year. The contracting limit is a political reality of the program.

APRIL 21 CONCEPTUAL MODEL WORKSHOP

On April 21st, an additional Conceptual Model Workshop was held in the Resources Building in Sacramento.

Matt Kondolf, UC Berkeley

The CALFED approach is to restore the functions of the ecosystem and at this point we do not know how the whole system works or how to fix it. Adaptive management is easy to understand "approximately". We all tend to do it, but it is more than trial and error. Uncertainty is the key. It is important to have a flexible management approach in light of uncertainty and the goal is to reduce the level of uncertainty. Interventions should be designed to learn more about the system and the goals should be clear. The effects of the interventions are then monitored and the results communicated so future actions can be adjusted.

There are different levels of uncertainty. Refer to the adaptive management diagram on page 15 of the PSP. The lower right hand corner identifies targeted research, pilot projects and large-scale implementation. Monitoring is important for every project. Locate your project on the Healy ladder. A project does not always have to start off with research.

Conceptual models are at the heart of adaptive management. There is not really a step-wise process. It is more that someone has an idea about how something works; he or she puts in on paper, and explains it to someone else.

In an estuarine ecology example (Figure 1), a table was developed that lists the species of interest across the top and the mechanisms affecting the species down the side. Different size circles show the linkages between the mechanisms and species. From the table, uncertainties can be identified which help identify research needs. Conversely, the table also describes what is known and actions that can be undertaken immediately. The important point is identifying all the relationships.

In a striped bass example (Figure 2), the life stages of the bass and relationship between the life stages and the environment are depicted in a graphic. It is important to think about the life cycle when an action is proposed which will (or will not) impact other life stages. It is also important to have narrative associated with a model to explain the graphic.

Another example is a conceptual model that shows alternative conceptual models (Figure 3). For instance, one model shows the importance of the delta for rearing of salmon and another model shows the importance of rivers in rearing of salmon. The arrows are different sizes and colors to explain different things. Again, explain what the arrows represent in the narrative.

Matt Kondolf provided the same spawning gravel example as in the April 12th workshop (see above). He also discussed models which describe river channel geomorphology (Figures 4 and 5) and the example of riparian habitat along the Sacramento River as described under the SB1086 program (Figure 6). Modeling has shown historic floodplain areas and a conservation corridor has been identified by the SB1086 program. For land acquisition within that area applicants should describe why that purchase is necessary, why it is important, and how it fits into the SB1086 program. An additional conceptual model example was provided on requirements for cottonwood establishment of the Sacramento River (Figure 7).

For any project, it is important to think in advance what will be learned. CALFED is in this for the long haul.

Question and Answer

Does a model lead you to hypotheses or hypotheses lead to development of a model? Think about the model first and then identify the hypotheses which are statements of how you think things work. The hypotheses will be embedded in the model.

On Page 55, the scientific components are listed out a, b, c, d, do we have to write them up that way?
It is important that all those aspects are addressed in the project description but they do not necessarily have to be listed out separately. There is a lot of interconnection among those components.

How are models for implementation projects developed?
A model for implementation should describe why the work is worth doing, what's proposed, how it ties in with ongoing activities, how the system currently works and why the current activities are not adequate. How will the project provide information, solve a problem and how does it all fit into the bigger picture?

How should we deal with science versus policy issues? There is the implementability aspect of projects that go beyond the science.
That is true and at times the policy issues will win. An example is fish screens where regulatory issues are involved. Fish screens are actually an example of non-adaptive management. Other possible solutions could be identified.

How much do I research other projects?
Each applicant should research and acknowledge ongoing activities in their area including papers or reports written on the topic of their proposal. The ERP is developing information now such as results from ongoing projects and white papers that will be useful for project applicants in the future.

Examples of conceptual models for large-scale restoration projects were requested.

How do you establish if existing information is valid?
Published information is usually well reviewed; however, much of the literature associated with CALFED is "gray literature" which is not peer reviewed. The best advice is to use common sense. The more information that can be referenced, the better. It is up to the applicant to assess the validity of available information. It is also recommended to talk with experts in the field.

Do tables, figures, or lists of references count in the 16-page limit for proposals?
No.

Where can I get more information on funded projects?
Every proposal that CALFED has received is on the CALFED website at http://calfed.ca.gov. Additional project information in a bit more detail may be found on the Natural Resources Project Inventory at http://endeavor.des.ucdavis.edu/nrpi/

To what extent have existing projects been monitored?
All projects require monitoring plans and for the ongoing projects, few have been completed to date. Data and reports will be posted to the website as they become available.

When will the ERP white papers be available for referencing?
The papers are under development and at different stages of completion. Drafts may be available for use by this fall.

Who will review the conceptual models? Will a scientist review educational conceptual models?
Review will be conducted by people with expertise in the proposal topic area. For example, a conceptual model in an education proposal will be evaluated by educational experts.

Can a project really evaluate screened and unscreened diversions when the regulating agencies may not provide permits to do such activities or may require the unscreened diversions to be screened?
This has been identified as an important issue and CALFED is working with the agencies to address these types of questions.